



## **Aquatic Habitat Connectivity Initiative**

*Stream Connectivity Restoration at Río Grande de Arecibo  
watershed of the Northcentral Region in Puerto Rico*

**DRAFT**  
Environmental Assessment

**Cambalache Dam Partial Removal/Modification  
Arecibo, Puerto Rico**

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In Cooperation With:  
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## 1.0 Project Location:

The Río Grande de Arecibo watershed, where the Cambalache dam occurs, is located in a subtropical wet zone in Puerto Rico and covers about 665 km<sup>2</sup> (166 square miles) receiving an average annual rainfall of almost two meters which is higher near the headwaters in the mountains (2.4 meters) and lower near the coastal valley (1.5 meters). However, as in many subtropical places, precipitation is highly variable and seasonal. In general, there is a dry season from January to April and rainy season from May to June followed by another dry season from June to August and the wet period that includes the hurricane season from September to December (Méndez-Lázaro and Martínez-Fernández 2010).

Figure 1. Río Grande de Arecibo Watershed



During the rainy season the area often receives short intense showers and thunderstorms caused by the orographic effect induced by the combination of the mountainous topography and the constant north-northeast winds. The average temperature ranges from 23 °C in the mountains and 29 °C in the coastal plains. Table 1 summarizes the 57 years average monthly discharge at Cambalache USGS station (50029000 in Fig. 1) reflecting the periodicity of rainfall in the Río Grande de Arecibo watershed.

Table 1. USGS Surface Water Data 57 Years Monthly Statistics Discharge at Cambalache Station, ft<sup>3</sup>/second.

	Monthly mean in ft <sup>3</sup> /s (January 1969 to September 2016)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Mean of monthly discharge</b>	318	257	253	380	576	431	345	450	680	758	746	516
** No Incomplete data have been used for statistical calculation												

The headwaters of the Río Grande de Arecibo begin in the mountains to the south of Adjuntas in the Cordillera Central just east of Monte Guilarte. It flows north-northeast about 65 km (40 miles) descending across the northern coastal plain to empty into the Atlantic Ocean near the municipality of Arecibo. The tributaries lie along the side of the Cerro de Punta and the municipality of Utuado. The Río Grande de Arecibo watershed has two main streams, the Río Grande de Arecibo to the west and Río Caonillas to the east. At the northern edge of the cordilleran foothills, the Río Grande de Arecibo is impounded by the Dos Bocas hydroelectric dam and reservoir system (1943), which is linked to the even larger Caonillas hydroelectric dam and reservoir upstream on the Caonillas River. Río Tanamá, another important tributary to the watershed, originates in the mountains of the municipality of Utuado flowing across the karst region through caves and tunnels before merging with the Río Grande de Arecibo.

From the headwaters, Río Grande de Arecibo runs through a narrow valley in a region characterized by forested areas and karst formations. Downstream, the river enters a wide alluvial floodplain below the PR-22 highway bridge. This coastal floodplain is approximately 4 kilometers wide and extends from the river mouth at the Atlantic Ocean to approximately 11 kilometers upstream. The primary developed area in the floodplain is the town of Arecibo, located along the western portion of the valley.

Aside from the larger dams used as water reservoirs and for hydroelectric power, the Río Grande de Arecibo and its tributaries hold several smaller water withdrawal structures and river crossings which may also constraint the aquatic life presence and use of their potential habitat (see Appendix 1). Some of those structures, such as the low-head dam proposed to be modified, have lost their usefulness or are not been utilized for their intended purposes but remain as barriers to the aquatic life. Base on the information in Appendix 1, it is estimated that the proposed action will make available approximately 25 river kilometers of potential habitat to migratory aquatic life.

The low-head dam proposed to be modified is located within the Río Grande de Arecibo watershed behind the old Cambalache sugar mill PR-2 in the municipality of Arecibo, Puerto Rico (18.45511°N, 66.70297°W). The low-head dam is constructed of rocks attached to each other and to the river bed with iron rods (Fig. 2). The dam is 11.4 meters in width, 43.9 meters long, and 4 meters high. It was originally constructed to enable neighboring communities to withdraw water, but it is no longer functional. The grounds that used to be part of the old sugar mill are currently being used by the Puerto Rico Electric Power Authority (PREPA) and a private gardening company that is leasing part of the lands and an old building.

### 1.1 National Environmental Policy Act

Pursuant to the requirements of the National Environmental Policy Act (NEPA), this Environmental Assessment (EA) analyzes potential impacts of the proposed project to elements of the natural and human environment as per the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508). Because federal funds administered by the Department of Interior are anticipated for use in the implementation of the project, the United States Fish & Wildlife Service (USFWS) is the lead federal agency for this proposed action. The purpose of the EA is to ensure the USFWS compliance with the regulations set forth by the CEQ provisions of NEPA, and the USFWS implementing regulations.

### 2.0 Purpose:

The USFWS in cooperation with the Puerto Rico Department of Natural and Environmental Resources (PRDNER), and Protectores de Cuencas, Inc (PDC) proposes to modify a the low-head dam in the Río Grande the Arecibo to increase stream connectivity and habitat heterogeneity thus enhancing and facilitating free movement of native aquatic life inhabiting the river. Increased connectivity and habitat heterogeneity may help protect populations of species of greater conservation need as designated by the USFWS and the PRDNER in the Río Grande de Arecibo watershed.

### 3.0 Need:

#### Effects of Stream Barriers on Aquatic Life

Numerous studies have documented the effects of large dams on the aquatic biota (e.g., Bednarek, 2001, American Rivers 2002, Hart et. al., 2002, Bunn and Arthington 2002, Neal et. al., 2009, Kwak et. al., 2007, Cooney and Kwak 2013, Luther 2015, Birnie-Gauvin et. al., 2017). Habitat generalists, lake oriented, and widely stocked species are commonly found upstream of barriers. Intolerant, stream-dependent, and imperiled species are the most likely to be absent upstream of barriers. Bunn and Arthington (2002) described the key principles linking hydrology and aquatic biodiversity to altered flow regimes. They highlighted and discussed the importance and implications of the following factors; 1) Flow is a major determinant of physical habitat in streams, which in turn is a major determinant of biotic composition; 2) Aquatic species have evolved life history strategies primarily in direct response to their natural flow regimes; 3) Maintenance of natural patterns of longitudinal and

lateral connectivity is essential to the viability of populations of many riverine species; and  
4) The invasion and success of exotic and introduced species in rivers is facilitated by the alteration of flow regimes.

The National Institute of Water and Atmospheric Research of New Zealand (NAVI) included the following factors in their summary of the effects of stream barriers on the life cycles and ecology of aquatic life:

- Altered fish migration - barriers may prevent native fish that move from sea to freshwater as part of their life cycle or from moving upstream and downstream and accessing otherwise suitable habitat.
- Increased velocity - sustained high water velocity prevents some fish access to upstream habitats.
- Modified channel form - erosion from vegetation removal along banks and changes to stream flow after construction of a road crossing or similar barrier can lead to scouring and breakdown of stream and river banks.
- Modified flow - flow changes as stream banks are modified and realigned, which can lead to changes in the benthic (bottom) structure of the stream/river bed when coarse substrates such as gravels and boulders are replaced and covered by sand and silt.
- Loss of species habitat - species need the protection and habitat provided at upstream sites inland from the sea. Barriers that make upstream habitat inaccessible to species that prefer higher elevation can result in loss of breeding and feeding sites.
- Decreased water clarity - erosion and increased sediment loading into a river due to changes in flow will decrease water clarity and reduce visibility and the ability of fish to find food.
- Increased nutrients - a decrease in flow may increase the concentration of nutrients within a river.

American Rivers et al. (1999) classified the reasons for dam removals into six categories (i.e, ecology, economics, failure, recreation, safety, and unauthorized dam):

- Ecology: dam was removed to restore fish and wildlife habitat; to provide fish passage; to improve water quality; to remediate environment; and to provide environmental mitigation credits.
- Economics: maintenance of dam was too costly; removal was cheaper than repair; dam was no longer used; and dam was in poor or deteriorating condition.
- Failure: dam failed; or dam was damaged in flooding.
- Recreation: dam was removed to increase recreational opportunities.
- Safety: dam was deemed unsafe; and owner no longer wanted liability.
- Unauthorized dam: dam was built without a needed permit; dam was built improperly; or dam was abandoned.

In this case, although the proposed action may be justified by the several factors mentioned above, the stream ecology and the need to protect species and their habitat are the major motivations. However, the impacts of smaller aquatic barriers such as low-head dams are not as obvious as the ostensible effects of large structures. ICF Consulting (2005) prepared a report summarizing the research available on low-head dam removal for the American Association of State Highway and Transportation Officials (AASHTO) Standing

Committee on the Environment. In their report, they indicate that removal of unneeded dams is often promoted under the assumption that dam removal will be inherently beneficial because the dam presence is detrimental to aquatic ecosystems. They argue that while dam removal can benefit many components of local ecosystems, removing a dam may also result in detrimental impacts. Appendix 2 is a summary of possible dam removal impacts obtained from the ICF Consulting (2005) report. These impacts may occur on short-, intermediate, and long-term time scales. The degree to which each potential impact may have an effect is site-specific and therefore should be considered given the unique parameters of a particular project site.

A limited number of studies have described the effects of smaller structures in the stream ecology, but the depicted implications range from negligible (Chick et al., 2006) to variable (Leroy and Hart 2002, Kwak et. al., 2007, Principe 2010, Bellucci 2011) and even positive (Smith 2012). For example, Chick et. al., (2006) studied fish communities in the upper Mississippi river and found that apparently fragmentation from low-head dams is minimal. Cooney and Kwak (2013) reported that both the dimensions of the dams and species swimming abilities affected the fish community composition above and below stream barriers. They found that many small dams did not constitute a barrier for gobies, however they did affect, in various degrees, the other native species. The table below, obtained from Cooney and Kwak (2013) summarize the effects of stream barriers on the distribution of native diadromous fish species in Puerto Rico.

Table 2. Obtained from Cooney and Kwak (2013)

Dam height (in meters) that blocks migration of amphidromous fish species and species groups at 50% and 95% of dam occurrences, with 95% prediction intervals (PI).

Species	50% blocking		95% blocking	
	Dam height	95% PI	Dam height	95% PI
Nongoby	1.9	1.4-2.4	4.1	2.8-5.4
Bigmouth sleeper	1.1	0.7–1.5	3.2	2.1–4.3
Mountain mullet	1.6	1.1–2.0	3.9	2.6–5.2
Smallscaled spinycheek sleeper	0.4	0.1–0.7	2.6	1.5–3.8
American eel	0.9	0.6–1.3	3.0	2.0–4.0
Goby	12.1	5.1–19.1	31.9	13.0–50.7
Sirajo goby	7.0	1.5–12.5	35.5	9.8–61.2
River goby	5.4	1.0–9.8	25.7	5.2–46.1

Another study on beaver dams (Smith 2012) suggests that some water obstructions may help increase habitat heterogeneity thus increasing richness and diversity of fish species.



Permeability of stream barriers may affect the migratory movements and behavior of diadromous species. Chick (2018; personal communication) indicated that the dams he studied were over flooded during rainfall events and that may have been a factor in his observations in the upper Mississippi river. As described above Cooney and Kwak (2013) observed that the height of dams, which probably affect their permeability, affects the ability of fish species to occupy upstream areas in Puerto Rico. Permeability seems dependent on both structural components of the dam and fish species intrinsic factors affecting their climbing ability.

Besides fishes, living organisms in Puerto Rico's streams include mollusks, crustaceans, and several other vertebrates. Some of the 77 species of fishes identified in Puerto Rico's streams have economic, recreational, subsistence, and cultural importance (Kwak et. al. 2007). Many species are amphidromous spending their lives in the freshwater streams and their larvae migrate to the estuaries while other are catadromous and the adults migrate to the ocean to spawn. The effects of barriers and altered flow on aquatic biodiversity have been documented by numerous studies (e.g., March et al. 2003, Johnson et al. 2008, Liermann et. al 2012, Cooney and Kwak 2013, Birnie-Gauvin et. al. 2017).

Cooney and Kwak (2013) described the ecological implications of low-head structures on Puerto Rico's stream fauna. They recognized stream connectivity together with habitat quantity, quality, among the most critical influences on community dynamics and the conservation of aquatic biodiversity and emphasized that anthropogenic activities have resulted in habitat loss, degradation, and fragmentation. In aquatic riverine environments, dams are constructed and operated to support services for humans but their effects on the aquatic community are widespread and severe, including hydrologic and habitat alterations in the upstream and downstream directions (March et al. 2003, Johnson et al. 2008, Birnie-Gauvin et. al. 2017). Fragmentation is particularly problematic for diadromous fauna that require connectivity between marine and freshwater habitats (Holmquist et al. 1998, Neal et al. 2011). The adverse effects documented include disruptions of migration, facilitation of incursions of exotic and invasive species, altered behavior patterns, and caused possible localized extirpation of some aquatic life populations.

The reproductive requirements of Puerto Rico's native fish species demand movement, either as larvae or as adults, from the freshwater streams to the estuaries or the open ocean. Stream system barriers such as dams and flow altering structures hinder the movements of fishes and other aquatic life in Puerto Rico's riverine systems. Native species inhabiting Puerto Rico's streams include gobies (*Gobiidae*), sleepers (*Eleotridae*), mountain mullets (*Mugilidae*), and eels (*Anguillidae*). The Sirajo goby (*Sicydium* spp.) dominates the upper upstream areas while the other native species are more abundant in the lower reaches (Holmquist et. al. 1998, Kwak et. al. 2007). Only one native species, the bigmouth sleeper (*Gobiomorus dormitor*) is known to complete its life cycle in freshwater (Neal et al. 2001, Bacheler et al. 2004). The climbing adaptations of gobies help them reach upstream of most small dams but are extirpated upstream of dams more than 32 meters high (Cooney and Kwak 2013). The presence of physical barriers such as dams built for agricultural, flood control, or potable water has excluded the 10 species of native fishes inhabiting

Puerto Rico's freshwaters from a large portion of their potential riverine habitats. Cooney and Kwak (2013) identified a total of 335 fish barriers, including 29 high dams, 208 low dams and 98 road crossings that hinder fish migration to 75% of Puerto Rico upstream riverine habitat. Cooney and Kwak (2013) described the length, in river kilometers (rkm) and accessibility to native species of streams affected with several types of barriers. Their information underscores the importance of the cumulative impact of barriers resulting in the eventual extirpation of species from their potential riverine habitat (see Appendix 3). In addition, preliminary information collected by Dr. Sean Locke from University of Puerto Rico at Mayagüez as part of the evaluation of aquatic resources in upstream and downstream from the low-head dam proposed to be modified, suggest that occurrence upstream of several estuarine fish species may be restricted by that aquatic barrier (2018 Interim Report USFWS Cooperative Agreement No. F16AC00898).

Therefore, the restoration and/or enhancement of river connectivity for the conservation of the migratory native freshwater species through the removal of barriers or the installation of fish passages has been identified as a top conservation priority in the USFWS Habitat Restoration Program Strategic Plans (i.e., Fish and Aquatic Habitat Conservation (FAC), Partners for Fish and Wildlife (PFW) and Coastal programs) and Puerto Rico 2015 State Wildlife Action Plan.

#### 4.0 **Proposed Action:**

This project seeks to reestablish and enhance river connectivity and increase stream habitat heterogeneity for the conservation of native freshwater species through the partial removal/modification of a physical barrier in the Río Grande de Arecibo of the northcentral region of Puerto Rico. This consensus approach was devised after an evaluation conducted in 2016 by the USFWS South East Aquatic Habitat Restoration Team (SEAHRT) in collaboration with the Caribbean Ecological Services Field Office (CESFO) and PRDNER staff to identify priority areas in Puerto Rico for aquatic restoration. The proposed action is to modify the existing low-head dam in order to improve aquatic connectivity and ecosystem integrity for the benefit of migratory native aquatic fauna such as the Sirajo goby, and *Anguilla rostrata* (American eel), considered species of Greatest Conservation Need in the U.S. Caribbean and other amphidromous freshwater fish and crustaceans that are considered Species of Concern. This project will enhance approximately 25 km of riverine habitat of the targeted species. A potential ancillary benefit would be the restoration of the river's path to a more natural position thus reducing the energy and eroding power on the western bank caused by the low-head dam's effect on the direction and force of the flux during rainfall events.

#### 5.0 **Public and Agency Involvement:**

The project has been coordinated with the PRDNER and the USFWS branches of Ecological Services, Science Applications and Fish and Aquatic Conservation. Scoping included an evaluation of the low-head dam by the USFWS SEAHRT Team, Eng. Moisés Sánchez Loperena (PRDNER), and on-going research by Dr. Sean Locke (UPRM) to determine the aquatic species' current condition in the proposed project site. In addition,

various visits to the area have been conducted with project's partners. A meeting with the mayor of the municipality of Arecibo and parties involved will be coordinated before this EA is finalized.

## 6.0 Alternatives Including the Proposed Action:

### 6.1 Alternative A (**Proposed Action**) Partial removal/modification of the low-head dam.

The low-head dam is comprised of multiple stones attached to each other and to the river bed with iron rods (Figure 2) will be partially removed/modified to enhance stream heterogeneity and connectivity and facilitate aquatic life movements within the river. Its dimensions are the following: length (43.9 m), width (11.4 m) and height (4 m). The proposed actions would be conducted by mechanical means through the use of a backhoe and two excavators; one equipped with a toothed bucket, and the other with a 5,000 lb hammer/breaker. The primary point of access (Figure 3) for the machinery to the site is located near the gate entrance to the old Cambalache sugar mill in PR-2. There is an asphalt road (Figure 4) behind the old building structures leading to the site; once closer to the river, the road is completely dirt. Vegetation clearing/removal in the access road will be needed prior to project implementation.



Figure 2. Low-head dam at Río Grande de Arecibo.





Figure 3. Google Earth image showing the identified potential point of access.



Figure 4. Asphalt road leading to the project site.

#### 6.1.1 USACE Nationwide Permit 53 Requirements

Most of the actions required to remove low-head dams are covered under the USACE Nationwide Permit 27 of March 19, 2012 “Aquatic Habitat Restoration, Establishment, and Enhancement Activities.” However, on March 19, 2017, the USACE developed a Nationwide Permit (NWP 53) to specifically address the removal of low-head dams. The information below are the relevant portions which may apply to the implementation of the proposed action.

NWP 53 authorizes discharges of dredged or fill material into waters of the United States and structures and work in navigable waters of the United States associated with the removal of low-head dams. There is no acreage limit for this NWP, but the authorized work is limited to the removal of the dam structure and

it requires a Section 401 water quality certification, since it authorizes discharges of dredged or fill material into waters of the United States.

Pre-construction notification is required for all activities authorized by this NWP. The preconstruction notification requirement allows district engineers to review proposed activities on a case-by-case basis to ensure that the individual and cumulative adverse environmental effects of those activities are no more than minimal. If the district engineer determines that the adverse environmental effects of a particular project are more than minimal after considering mitigation, then discretionary authority will be asserted, and the applicant will be notified that another form of DA authorization, such as a regional general permit or individual permit, is required (see 33 CFR 330.4(e) and 330.5).

When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type(s) of resource(s) that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. These criteria are listed in the NWPs in Section D, "District Engineer's Decision." If an appropriate functional or condition assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse environmental effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns. The removed low-head dam structure must be deposited and retained in an area that has no waters of the United States unless otherwise specifically approved by the district engineer under separate authorization. Because the removal of the low-head dam will result in a net increase in ecological functions and services provided by the stream, as a general rule compensatory mitigation is not required for activities authorized by this NWP. However, the district engineer may determine for a particular low-head dam removal activity that compensatory mitigation is necessary to ensure the authorized activity results in no more than minimal adverse environmental effects.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity. (See general condition 32.)  
Authorities: Sections 10 and 404)

#### **6.1.2 Site Specific Conditions**

General condition 23 requires the permittee to minimize and avoid impacts to waters of the United States to the maximum extent practicable on the project site.

Off-site alternatives cannot be considered for activities authorized by NWP. During the evaluation of a preconstruction notification, the district engineer may determine that additional avoidance and minimization is practicable. The district engineer may also condition the NWP authorization to require compensatory mitigation to offset losses of waters of the United States and ensure that the net adverse environmental effects are no more than minimal. As another example, the NWP authorization can be conditioned to prohibit the permittee from conducting the activity during specific times of the year to protect spawning fish and shellfish. If the proposed activity will result in more than minimal adverse environmental effects, then the district engineer will exercise discretionary authority and require an individual permit. Discretionary authority can be asserted where there are concerns for the aquatic environment, including high value aquatic habitats. The individual permit review process requires a project-specific alternatives analysis, including the consideration of off-site alternatives, and a public interest review.

#### 6.2 Alternative B (No Action) Low-head dam will remain unmodified.

The no action alternative will not result in benefits to the aquatic species of Greatest Conservation Needs or Species of Concern inhabiting the Río Grande the Arecibo. The species will continue subjected to the deleterious effects described above caused by the aquatic barriers in stream ecosystems. The no action alternative will not change the current sediment transport regime and no potential impacts are expected downstream below the dam, in the estuary or the adjacent coastal area. River connectivity will not be restored and hindered aquatic life movements and reduced ecosystem functionality will linger.

#### 6.3 Alternative C (Complete removal of the low-head dam).

Complete removal of the low-head dam would not result in foreseeable additional benefits to the aquatic life as compared to the proposed project and would not further enhance the needed connectivity as compared to the partial removal and rearrangement of the structure. Complete removal will not result in increased habitat heterogeneity. Furthermore, complete removal would potentially result in increased sediment loads although it probably would also be limited and temporary. Complete removal would create the need to relocate and dispose of the boulders and fill material thus increasing the project cost and may potentially temporarily affect the aquatic life and its habitats in the project area. Moreover, this alternative is less cost effective.

#### 6.4 Alternative considered but removed from further consideration.

We considered the possibility of using fish ladders to enhance connectivity in the area. However, the alternative was discarded as the location and composition of the dam is not conducive to the use of fish ladders as the best alternative to enhance stream connectivity.

## 6.5 Summary of Actions by Alternatives.

Action	Result	Expected outcomes
Partial removal/modification	Partial removal/modification of the low-head dam.	Improved connectivity and facilitated movements of aquatic fauna. Reduced erosion on the river western bank. Small project footprint.
No-Action	The low-head dam remains as it is.	Stream remains fragmented and hindered movements of aquatic fauna. The low head-am will continue redirecting the stream force into the river western bank.
Complete Removal	Removal and disposal of the low head dam material.	Improved connectivity and facilitated movements of aquatic fauna. Reduced erosion on the river western bank. Increased disposal cost of removed material and sediment loads. Potentially larger project footprint.

## 7.0 Affected Environment:

The affected environment potentially comprises a large portion of the Río Grande de Arecibo watershed in terms of enhanced connectivity and facilitating movement of aquatic fauna. Nevertheless, the actual action will directly affect a limited stretch of Río Grande de Arecibo beginning where the low head dam is located (18.45511°N, 66.70297°W) about 2.78 km from the river mouth and potentially downstream to the river mouth and adjacent coastal area. The expected immediate effect would be unbarred downstream flow and stream connectivity. Temporary potential effects may result from sediment loads moving downstream to the estuary and the immediate coastal area near the river mouth during the implementation of the proposed action. We expect the sediment transport will be reduced and comparable to sediment loads during average river surges caused by rainfall events. Furthermore, the project implementation will be timed to coincide with the dry season when the river flow is at its lowest thus reducing the sediments transported to adjacent aquatic habitats. In addition, systematic surveys are been used, and will be repeated after the rearrangement and partial removal of the low-head dam, to obtain information on the stream biota and data on physicochemical parameters to help determine the effects of the management action on the stream habitat. The surveys are conducted using the 3-pass removal fish protocol described by Kwak et.al. (2007). The survey information will inform the concerned agencies on possible corrective measures and adjustments if necessary. However, based on the scientific knowledge on the effects of barriers on aquatic life we expect the proposed action will result in improvements to the aquatic habitat and ecosystem functionality for the benefit of the identified focal species.

## 8.0 Environmental Consequences:

### 8.1 Alternative A (Proposed Action)

#### A. Wetland Habitat Impacts

The major environmental impacts expected are an increase in stream connectivity and enhance movement of river biota. There could be some limited short-term ecological consequences of dam removal, however, Bednarek's (2001) indicated that the long-term ecological benefits of dam removal, as measured in improved water quality, sediment transport, and native resident and migratory species recovery, validate the effectiveness of dam removal as a long-term river restoration tool. The proposed action may result in temporary disruptions in the river flow and increased sediment transport during the implementation phase. All the anticipated potentially negative effects are expected to be temporary and should negligible after the conclusion of the implementation phase. The use of heavy equipment may disrupt the river bank by the need to deposit temporary fill as a platform to move heavy equipment within the river, but the impact should be minor and localized, and the area could be easily restored after the proposed action is implemented. Relocation of boulders within the river to increase stream habitat heterogeneity may also cause some minor disruptions.

The proposed action may also help alleviate the erosion on the river western bank caused by the redirection of the flow and energy of the current caused by the low-head dam during heavy rainfall events. The effects of the low-head dam are evident in Figure 5.



Figure 5. Google Earth Image showing erosion on the western bank of the Río Grande de Arecibo and the formation of a sediment bank on the eastern bank caused by the effects of the low-head dam on the river flow.



B. Water Quality and Quantity

The entire footprint of the project is less than an acre. There is a possibility of minor temporary impacts on water quality during the implementation of the proposed action due to increased sediment loads caused by the use of heavy machinery. The impact will be temporary, and the river water quality should return to its normal parameters after the rearrangement of the low-head dam is completed. The project should not have any other effect in water quantity.

C. Wildlife Impacts

As explained above the effects of proposed actions are intended is habitat enhancement for aquatic species in the river. Other aquatic wildlife may be temporality affected during the implementation phase of the proposed action, but no long-term or permanent negative effects are anticipated, and the possible impacts are considered localized and minimal.

D. Impacts to Endangered, Threatened and At-Risk Species

The endangered Puerto Rican boa (*Chilabothrus inornatus*, formerly *Epicrates inornatus*) may occur within the project site. The USFWS Conservation Measures for the boa will be fully implemented (Appendix 4) to avoid or minimize possible effects on the Puerto Rican boa during the project implementation. We do not expect any disturbances to the boa or its habitat during and after the implementation of the proposed action. Although minor impacts may result from sediment movement downstream reaching the coastal areas, effects to marine ecosystems are not anticipated. Based on the nature of the proposed action, habitat characteristics and the implementation of conservation recommendations for the Puerto Rican boa, the USFWS has determined that the project is not likely to adversely affect the PR boa or its habitat.

The Río Grande de Arecibo harbors habitat for aquatic species such as the American eel (*Anguilla rostrata*) and Sirajo goby (*Sicydium* spp.) that are considered species of Greatest Conservation Need in the U.S. Caribbean, and other native aquatic fish and crustaceans. We anticipate that the partial removal of the low-head dam will result in habitat heterogeneity providing staging and resting places for diadromous fish species inhabiting the area. In addition, the proposed project will lessen any adverse effects that physical barriers might have on the aquatic fauna maintaining the connectivity for migratory aquatic species. An Intra-Service Section 7 consultation was completed in compliance with the Endangered Species Act (ESA) in September 4, 2018 (Appendix 5).

E. Economic Impacts

Many of the fish species present in Río Grande de Arecibo have recreational and cultural importance. A major cultural and economic activity directly related to stream connectivity is the harvesting of *cetí*, fish post-larvae considered a local delicacy. Some people believed they are the larvae of the Sirajo goby but apparently the harvest contains several fish species (Kwak et. al. 2007). There is some subsistence fishing (fish and crustacean) in the river but the extend and impact of the activity in the aquatic resources in the area have not been properly studied. Improving connectivity may eventually result in a positive impact to the local economy by increasing health and resilience of the aquatic life. However, at this moment we do not have the information necessary to discern an economic outlook.

F. Historic and Cultural Resources

Review of the Puerto Rico State Site Files revealed two historic properties in the immediate vicinity of the low-head dam: The Central Cambalache Sugar Mill and the Cambalache Historic Bridge. The double Pratt truss bridge, which is associated with the American Railroad Company, was listed on the National Register of Historic Places in 1995. In 2002, the early 20th century sugar mill site consisted of two smoke stacks, a boiler, ruins of the mill, and a “batey”. Most of the remains were demolished in 2010. Current use of the mill site is by the Puerto Rico Electric Power Authority (PREPA) and a private gardening company that is leasing part of the lands and an old building. The low-head dam is not considered to be a historic property due to its recent age and poor condition. Most of the remains of the Central Cambalache Sugar Mill were removed in 2010. As this site no longer retains any integrity, it is not considered to be eligible for the National Register. Also, the Cambalache Historic Bridge is outside of the project’s footprint, therefore, we believe that the partial removal of the low-head dam will have “no adverse effect” on the National Register-listed bridge or its viewshed. Furthermore, the use of this area to access the work site and/or temporarily store heavy equipment will have “no effect”, since historic properties are no longer present at the site. The USFWS concluded consultation pursuant to Section 106 of the Historic Preservation Act as per letter from the Puerto Rico State Historic Preservation Office (PRSHPO) received in our office in August 13, 2018 (Appendix 6).

G. Flooding and Flood Control

We visited the low-head dam accompanied with an engineer from the PRDNER as the possibility of flooding caused by the alteration of the dam was a concern. However, the engineer believes the low-head dam intended to be removed does not constitute a significant flood control structure. The river often covers the entire structure during regular rainfall events and removal of the structure will no significantly increase the volume and energy of water moving downstream. He observed, however, that the removal of the dam may help alleviate the erosion caused by the effects of the low-head dam directing the stream energy to the western river bank.

## 8.2 Alternative B (No Action)

### A. Wetland Habitat Impacts

The boulders forming the dam will remain undisturbed in their current locations. Stream connectivity and movement of the aquatic biota will continue hampered by the effects of the low-head dam. No temporary disturbances in the river sediment loads or flow regime will result from the no-action alternative.

### B. Water Quality and Quantity

Water quality and quantity will remain unaltered.

### C. Wildlife Impacts

Wildlife implications by the no action alternative may include diminished populations of At Risk Species and Species of Concern due to limited stream connectivity affecting their mobility to and from the river mouth to complete their life cycles.

### D. Impacts to Endangered, Threatened and At-Risk Species

The no action alternative will not affect currently listed species. However, if the hampered river connectivity continues to affect the reproduction of diadromous species, it may result in the eventual need to consider listing aquatic At-Risk or Species of Concern presently inhabiting the river.

### E. Economic Impacts

Albeit minor, the reduced reproduction of amphidromous species in the river may affect the traditional cultural activities and hence the economy derived from them based in the harvesting of cetí.

### F. Historic and Cultural Resources

The no action alternative will not affect historic or cultural resources in the area.

### G. Flooding and Flood Control

As the low-head dam has a minimal influence as flooding control structure, the partial removal or non-removal of the structure should not have significant consequences in the flooding of downstream areas.

## 8.3 Alternative C (Complete Removal of the Low-head Dam)

### A. Wetland Habitat Impacts

In general, based on published research and information on the aquatic life in the area, we estimate the implications of the implementation of alternative C in terms of increased connectivity and continuity of stream flow in the Río Grande the Arecibo and its effect on aquatic biodiversity would be similar to the effects of implementing Alternative A. Complete

removal of the low-head dam would help achieve that goal. The complete removal, however, will not help create the desired habitat heterogeneity in the stream. Therefore, no additional benefits, as compared to alternative A, would be achieved, whereas the complexity and cost would increase by the implementation of alternative C. Part of the increased cost would result by the need to identify and pay for a disposal site and the cost of transportation of the disposed material. The potential negative effects as related sediment movement downstream and temporary disruptions of the river bank would increase as compared to alternative A but may still be negligible in the long run.

**B. Water Quality and Quantity**

Again, the impacts of implementation of Alternative C would have similar temporary effects to the expected outcomes from Alternative A. Also, the acute response may be more severe, as the complete removal of the dam requires more management of the boulders on the stream with the potential to cause more disturbances to the stream bed, but the overall impact is not expected to be long lasting or significant.

**C. Wildlife Impacts**

The impacts to wildlife in the area should not be substantially different from the impacts of Alternative A.

**D. Impacts to Endangered Threatened and At-Risk Species**

We do not expect impacts to Federally listed species different from the effects of implementation of alternative A.

**E. Economic Impacts**

Economic impacts should also be similar to the ones resulting from the implementation of alternative A.

**F. Historic and Cultural Resources**

Possible consequences of the complete removal of the low-head dam should not differ from the impact of the proposed action.

**G. Flooding and Flood Control**

As the low-head dams has a minimal influence as flooding control structure, complete removal of the structure should not have significant consequences in the flooding of downstream areas

#### 8.4 Summary of Environmental Consequences by Alternative

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U.S. Fish and Wildlife Service, Partners for Fish and Wildlife

U.S. Fish and Wildlife Service, Fish and Aquatic Conservation  
U.S.D.A Forest Service  
Puerto Rico Department of Natural and Environmental Resources

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## 12.0 Appendices

Appendix 1. Dams and other water barriers in the Río Grande de Arecibo and its tributaries.

Type	River Name	Fish Ladder Present	Distance to River Mouth (km)	Elevation (m)	Total Height (m)	Height for fish (m)	Width (m)	Wetted Width (m)	Length (m)	Material	Primary Purpose
Dam	Arecibo	No	2.78	3	4	2.3	43.9	43.9	11.4	Stone	Water Withdrawal
Dam	Arecibo	No	5.71	8	0.35	0.35	18	14	5.3	Cement, Stone	Water Withdrawal
Dam	Arecibo	No	25.03	48	57.3	55	350	83	84	Cement	Hydroelectric
Dam	Arecibo	No	44.90	190	14	11.5	43.5	2.5	4	Cement, Stone	Water Withdrawal
Dam	Arecibo	No	51.80	362	48.5	40.5	65	23	11.5	Cement	Water Withdrawal
Road	Arecibo	No	18.57	26	1.5	0.7	78	78	20	Cement	Road Crossing
Road	Arecibo	No	40.80	146	5	0	49.5	30	10	Cement	Road Crossing
Dam	Tanama	No	9.64	21	10	10	32.5	26	4.1	Cement	Water withdrawal
Dam	Tanama	No	10.52	85	8.5	8	24	13	2	Cement	Water Withdrawal
Dam	Tanama	Yes	15.51	117	1.8	0.85	23	22	1	Cement	Water Withdrawal
Dam	Tanama	Yes	36.14	431	3	1.5	26	23	2.6	Cement	Water Withdrawal

Appendix 2. Possible dam removal impacts obtained from the ICF Consulting (2005) report.

These impacts may occur on short-, intermediate, and long-term time scales. The degree to which each potential impact may have an effect is site-specific and therefore should be considered given the unique parameters of a particular project site.

Category of Impact		Potential Type of Impact
<i>Physical and Chemical Impacts</i>	Riverine Hydrology	<ul style="list-style-type: none"> <li>• Changes to downstream hydrologic regime</li> <li>• Changes in groundwater recharge</li> </ul>
	River Morphology	<ul style="list-style-type: none"> <li>• Changes to stream channel hydrogeometry</li> <li>• Changes to stream slope</li> <li>• Changes to retention time of water and sediment</li> <li>• Streambed degradation upstream of impoundment</li> <li>• Relocation of original channel in former impoundment</li> <li>• Change in channel type upstream of impoundment</li> <li>• Streambed aggradation downstream of dam</li> <li>• Re-exposure of natural physical characteristics (e.g., ledge, boulders)</li> <li>• Exposure of manmade physical characteristics (e.g., pipeline)</li> <li>• Transport and deposition of woody debris</li> </ul>
	Flooding	<ul style="list-style-type: none"> <li>• Change in flood elevations upstream of dam</li> <li>• Change in flood elevations downstream of dam</li> </ul>
	Sediment Transport	<ul style="list-style-type: none"> <li>• Change in sediment transport capacity</li> <li>• Change in suspended sediment load</li> <li>• Change in transport of bed-load material</li> <li>• Change in rate and location of sediment deposition</li> <li>• Redistribution and relocation of contaminants</li> <li>• Change in bioavailability of contaminants</li> </ul>
	Erosion	<ul style="list-style-type: none"> <li>• Rate of stream bank sloughing/bank failure</li> <li>• Amount of stream bank sloughing/bank failure</li> <li>• Location of stream bank sloughing/bank failure</li> </ul>
	Wetlands	<ul style="list-style-type: none"> <li>• Surface water and groundwater hydrology</li> <li>• Change in duration, frequency and timing of inundation</li> <li>• Change in location and extent of hydric soils</li> <li>• Change in wetland type(s)</li> </ul>

		<ul style="list-style-type: none"> <li>• Change in wetland extent</li> <li>• Change in wetland community(ies)</li> <li>• Change in wetland function(s)</li> </ul>
	Water Quality	<ul style="list-style-type: none"> <li>• Change in retention time for carbon and nutrients</li> <li>• Change in rates of biogeochemical reactions (e.g., plant uptake, nitrification, denitrification, anaerobic/aerobic sediment/water interface)</li> <li>• Change to water temperature, turbidity, alkalinity, dissolved oxygen, pH, nutrient loads, etc. upstream and downstream of the dam</li> </ul>
Ecological Impacts	Aquatic Habitats	<ul style="list-style-type: none"> <li>• Change from lentic to lotic conditions</li> <li>• Altered hydrology may affect aquatic habitats and organisms</li> <li>• Altered morphology may affect aquatic habitats and organisms</li> <li>• Altered water quality may affect aquatic habitats and organisms</li> <li>• Altered sediment transport and deposition may affect aquatic habitats and organism</li> <li>• Diurnal and seasonal affects due to altered physical and chemical conditions of aquatic habitat.</li> <li>• Reconnection of stream segments may affect fish movement and fecundity (for both migratory and resident species)</li> <li>• Alterations may affect various life stages of aquatic organisms.</li> </ul>
	Vegetation	<ul style="list-style-type: none"> <li>• Change in areal extent of aquatic and terrestrial vegetative communities upstream of dam</li> <li>• Change in type of aquatic and terrestrial vegetative communities upstream of dam</li> <li>• Change in type of aquatic and terrestrial vegetative communities downstream of dam</li> <li>• Succession of vegetative communities due to hydrologic changes</li> <li>• Alterations in the location of erosion and deposition of sediment may affect vegetative communities</li> </ul>

		<ul style="list-style-type: none"> <li>• Change in viability of nonnative and/or invasive species</li> </ul>
Social Impacts		<ul style="list-style-type: none"> <li>• Changed aesthetics</li> <li>• Effects to historic and cultural resources</li> <li>• Change in recreational opportunities (lake or pond-based to river-based)</li> </ul>
		<ul style="list-style-type: none"> <li>• Change in property values</li> <li>• Change in land ownership (e.g., exposed land may revert to riparian landowners)</li> <li>• Conflict due to local attitudes toward the project</li> <li>• Change in social classes residing in or visiting area (e.g., panfishing replaced by trout fishing)</li> </ul>
Economic Impacts		<ul style="list-style-type: none"> <li>• Cost of dam removal (e.g., planning, permitting, construction)</li> <li>• Cost of stream restoration</li> <li>• Cost of infrastructure retrofits (e.g., extending storm sewer outfalls)</li> <li>• Elimination of recurring dam repair costs</li> <li>• Elimination of long-term operating and maintenance costs for dam</li> <li>• Elimination of impoundment management</li> <li>• Elimination of liability risks associated with dam</li> <li>• Cost of replacing dam's benefits (e.g., flood control, hydropower, fire suppression, irrigation, recreation)</li> <li>• Revenue due to new business opportunities (e.g., revitalized waterfront)</li> <li>• Revenue due to new recreational opportunities</li> <li>• Change in property values</li> <li>• Change in cost of water and wastewater treatment</li> </ul>

Appendix 3. Data from Cooney and Kwak (2013) underscoring the effects of multiple barriers on the aquatic life accessibility to their potential habitat.

***The length and accessibility of affected habitat (in river kilometers [rkm], out of 9187.02 total rkm) and cumulative affected habitat (in rkm) of Puerto Rico rivers with artificial barriers of varying height.***

<b>Artificial barrier height (in meters)</b>	<b>Length of the river habitat affected by barriers of this height</b>	<b>Proportion of the total habitat affected by barriers of this height</b>	<b>Length of the river habitat affected by barriers of this or greater height</b>	<b>Proportion of the total habitat affected by barriers of this or greater height</b>	<b>Habitat status for non-goby species</b>	<b>Habitat status for goby species</b>
0.0-0.1	2340.92	0.255	9187.02	1.000	Accessible	Accessible
0.1-1.9	1575.93	0.171	6846.10	0.745	Accessible	Accessible
1.9-4.1	1695.24	0.185	5270.17	0.574	Restricted	Accessible
4.1-12.1	280.33	0.031	3574.93	0.389	Extirpated	Accessible
12.1-31.9	1306.42	0.142	3294.60	0.358	Extirpated	Restricted
31.9 and higher	1988.18	0.216	1988.18	0.216	Extirpated	Extirpated

*Note: Accessible* river lengths were available to all individuals of the fish assemblage component. *Restricted* lengths allowed access to the assemblage component at 50% of barrier occurrences. *Extirpated* lengths were unavailable to all individuals of the assemblage component. See the text for information on the species surveyed.

Appendix 4. USFWS Information for Planning and Consultation (IPaC) – Listed species (Puerto Rican boa: *Chilabothrus inornatus*, formerly *Epicrates inornatus*) present in the project site and conservation measures for the Puerto Rican boa.



## United States Department of the Interior

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In Reply Refer To:

August 30, 2018

Consultation Code: 04EC1000-2018-SLI-0698

Event Code: 04EC1000-2018-E-00784

Project Name: Stream Connectivity Restoration Initiative at the Río Grande de Arecibo watershed of the Northcentral

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

**\*THE FOLLOWING SPECIES LIST IS NOT A SECTION 7 CONSULTATION. PLEASE CONTACT OUR OFFICE TO COMPLETE THE CONSULTATION PROCESS\***

The purpose of the Endangered Species Act (Act) is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect those species and/or their designated critical habitat.

Federal agencies are required to "request of the Secretary of Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action". The enclosed species list provides information to assist with the consultation process with the U.S. Fish and Wildlife Service (Service) under section 7 of the Act. However, the enclosed species list **does not complete the required consultation process**. The species list identifies threatened, endangered, proposed and candidate species, as well as proposed and designated critical habitats, that may occur within the boundary of your proposed project and/or may be affected by your proposed project.

A discussion between the Federal agency and the Service should include what types of listed species may occur in the proposed action area, and what effect the proposed action may have on those species. This process initiates informal consultation.

When a Federal agency, after discussions with the Service, determines that the proposed action is not likely to adversely affect any listed species, or adversely modify any designated critical habitat, and the Service concurs, the informal consultation is complete and the proposed project moves ahead. If the proposed action is suspected to affect a listed species or modify designated critical habitat, the Federal agency may then prepare a Biological Assessment (BA) to assist in its determination of the project's effects on species and their habitat.

However, a BA is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a BA where the agency provides the Service with an evaluation on the likely effects of the action to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a BA are described at 50 CFR 402.12.

If a Federal agency determines, based on its BA or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to further consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species, and proposed critical habitat be addressed within the consultation process.

More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

<http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF>

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

Additionally, wind energy projects should follow the wind energy guidelines (<http://www.fws.gov/windenergy/>) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at:



<http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm>; <http://www.towerkill.com>; and <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html>.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

**For more information:**

**U.S. Fish and Wildlife Service**

**Caribbean Ecological Services Field Office**

**Road 301, Km. 5.1 / Bo. Corozo**

**Boquerón, PR 00622**

**Telephone: (787) 851-7297**

**Fax: (787) 851-7440**

**Email: [caribbean\\_es@fws.gov](mailto:caribbean_es@fws.gov)**

**<http://www.fws.gov/caribbean/es>**

**Send all documents to:**

**U.S. Fish and Wildlife Service**

**P.O. Box 491**

**Boquerón, Puerto Rico 00622**

Attachment(s):

- Official Species List
- Wetlands

# Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

## **Caribbean Ecological Services Field Office**

Post Office Box 491

Boquerón, PR 00622-0491

(787) 851-7297

## **Project Summary**

Consultation Code: 04EC1000-2018-SLI-0698

Event Code: 04EC1000-2018-E-00784

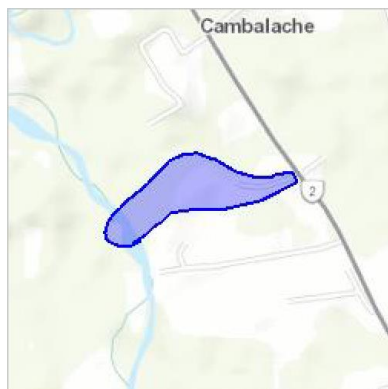
Project Name: Stream Connectivity Restoration Initiative at the Río Grande de Arecibo watershed of the Northcentra

Project Type: DAM

Project Description: The proposed project seeks to reestablish river connectivity for the conservation of native freshwater species through the partial removal or modification of a low-head dam located within the Río Grande de Arecibo watershed in the municipality of Arecibo.

Project Location:

Approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/place/18.455835118807155N66.70071998083247W>



Counties: Arecibo, PR.

## Endangered Species Act Species

There is a total of 1 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries<sup>1</sup>, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

- 
1. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

### Reptiles

NAME

STATUS

Puerto Rican Boa *Epicrates inornatus*

Endangered

No critical habitat has been designated for this species.

Species profile: <https://ecos.fws.gov/ecp/species/6628>

General project design guidelines:

<https://ecos.fws.gov/ipac/guideline/design/population/156/office/41430.pdf>

### Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

## Wetlands

Impacts to [NWI wetlands](#) and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local [U.S. Army Corps of Engineers District](#).

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

ESTUARINE AND MARINE DEEPWATER

- [E1UBL](#)

#### FRESHWATER EMERGENT WETLAND

- [PEM1/SS3A](#)

#### FRESHWATER FORESTED/SHRUB WETLAND

- [PFO3A](#)
- [PSS3/EM1A](#)

## CONSERVATION MEASURES FOR THE PUERTO RICAN BOA - USFWS

### General Information:

The Endangered Puerto Rican boa (*Epicrates inornatus*) is an endemic species and it is the largest snake that inhabits the Puerto Rico Island Shelf. The color and pattern of the Puerto Rican boa is highly variable. The species color can range from tan to dark brown with irregular diffuse marking on the dorsum but some individuals lack marking and are uniformly dark. Juveniles have reddish brown ground color with numerous pronounced markings. The Puerto Rican boa can be found in the habitat range from the sea level to about 400 m of elevation. The boa tolerates a wide variety of habitat types ranging from wet montane to subtropical dry forest and can be found from virgin forest to areas that exhibit various degrees of human disturbance like roadside or out buildings. Boas are more active at night, remaining less active concealed or basking in the sun during the day. The U.S. Fish and Wildlife Service (Federal Register October 13, 1970) listed the Puerto Rican boa (*Epicrates inornatus*) as endangered in 1970 and it is protected by the Endangered Species Act of 1973, as amended. Any person that injures, captures, or kills a Puerto Rican boa is subject to penalties under federal law of up to \$100,000, one year in prison or a combination of both.

### Recommendations:

The U.S. Fish and Wildlife Service (hereafter the Service) has developed recommendations to avoid or minimize impacts on the boa during a project development in an area where the boa may occur. The recommendations are the following:

- A. Prior to any earth movements or vegetation clearing, the boundaries of the project area, the buffer areas and areas to be protected should be clearly marked in the project plan and in the field.
- B. A pre-construction meeting should be conducted to inform supervisors and employees about the conservation of protected species, as well as penalties for harassing or harming such species.
- C. Prior to any use of machinery on areas where the boa may occur, the vegetation should be cleared by hand to provide time to the boa, if present, to be detected or move away from the area. All personnel involved in site clearing must be informed of the potential presence of the

snake, and the importance of protecting the snakes.

- D. Before activities commence each workday during the vegetation clearing phase, the experienced personal in identifying and searching for boas should survey the areas to be cleared that day, to ensure that no boas are present or affected within the work area. If boas are found within the working area, activities should stop at the area where the boas are found until the boas move out of the area on their own. Activities at other work sites, where no boas have been found after surveying the area, may continue. If relocation of the species is necessary, any relocated boas should be transferred by authorized personnel of the Department of Natural and Environmental Resources (DNER) to appropriate habitat close to the project site. Any findings should be reported to the Service and to the DNER Ranger office so they can further assist you in developing sound conservation measures and specific recommendations to avoid, minimize and/or compensate for any impacts to this species.
- E. Strict measures should be established to minimize boa casualties by motor vehicles or other equipment. Before operating or moving equipment and vehicles in staging areas near potential boa habitats (within 25 meters of potential boa habitat), these should be thoroughly inspected to ensure that no boas are lodged in the standing equipment or vehicles. If boas are found within vehicles or equipment, authorized personnel of DNER must be notified immediately for proper handling and relocation. Any relocated boas should be transferred to appropriate habitat close to the project site.

F.

For more information:

**US Fish and Wildlife Service  
Caribbean Ecological Services Field Office Road  
301, Km. 5.1 / Bo. Corozo  
Boquerón, PR 00622**

**Telephone: (787) 851-7297**

**Fax: (787) 851-7440**

**Email: [caribbean\\_es@fws.gov](mailto:caribbean_es@fws.gov)**

**INTRA-SERVICE SECTION 7 BIOLOGICAL  
EVALUATION FORM**

**Division/Office:** Caribbean Ecological Service Field Office

**Project Biologist/Phone#:** Alexandra M. Galindo  
787-851-7297 Ext.223

Date: September 4, 2018

**I. Proposed Action:**

The proposed project seeks to reestablish river connectivity for the conservation of native freshwater species through the partial removal and/or modification of a low-head dam located within the Río Grande de Arecibo watershed in the municipality of Arecibo.

**II. Location (County and State/attach project area map):**

The identified low-head dam is located within the Río Grande de Arecibo watershed behind the old Cambalache sugar mill PR-2 in the municipality of Arecibo, Puerto Rico (18.45511°66.70297°W). The tax property identification numbers of the project site are the following: Parcel 1 (030-000-009-XX: 18.457, -066.703) and Parcel 2 (030-000-004-08: 18.456, -066.700). At present the dam is not functional since the sugar mill ceased operations in 1981. The dam is at a distance of 2.78 km to the river mouth and elevation of 3 m. The proposed action is to partially remove and/or modify the existing low-head dam in order to improve aquatic connectivity and ecosystem integrity for the benefit of migratory native aquatic fauna such as the Sirajo goby (*Sicydium spp.*) and American eel (*Anguilla rostrata*) that are considered Species of Greatest Conservation Needs in the Caribbean and other amphidromous freshwater fish and crustaceans that are considered Species of Concern. The grounds that used to be part of the old sugar mill are currently being used by the Puerto Rico Electric Power Authority (PREPA) and a private gardening company is leasing part of the lands and an old building. The USFWS-CESFO concluded consultation pursuant to Section 106 of the Historic Preservation Act with the Puerto Rico State Historic Preservation Office (PRSHPO). The PRSHPO supported the Service's finding of no historic properties affected within the project's area of potential effects.

Sattelite map showing the project site



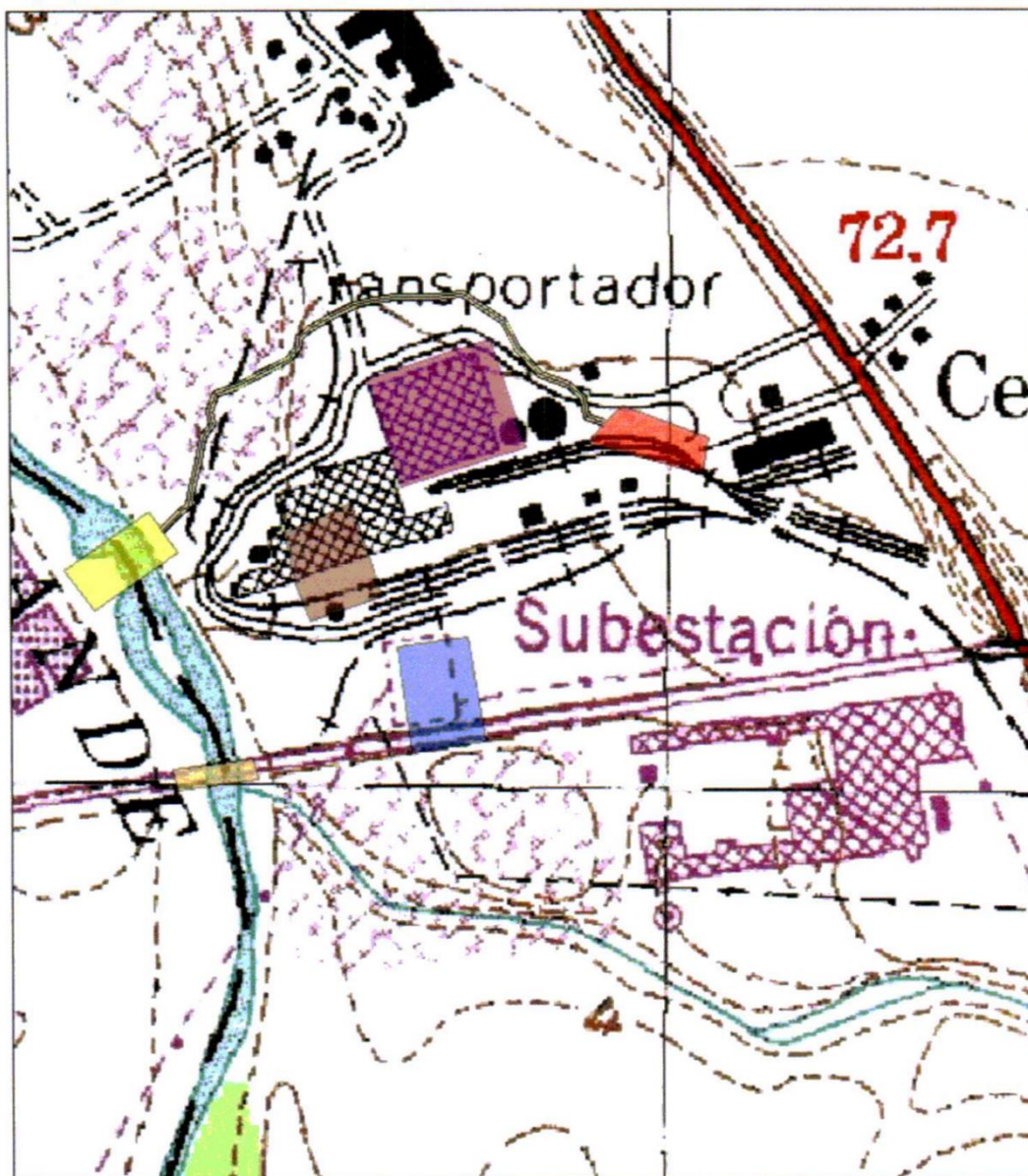
**Central Cambalache Sugar Mill Area**

**Legend**

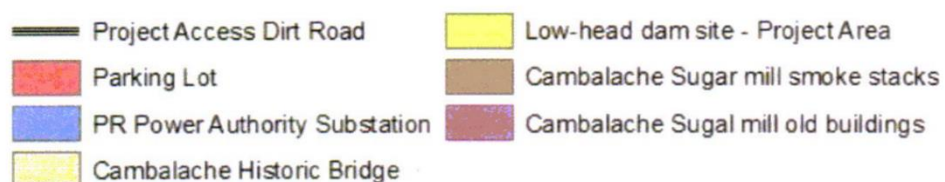
- |   |  |
|---|--|
|  Low-head dam site-project area  |  Parking Lot                      |
|  Project Access Dirt Road        |  PR Power Authority Substation    |
|  Central Cambalache Smoke stacks |  Cambalache Historic Bridge       |
|   |  Central Cambalache old buildings |



Topographic map showing the project site



### Río Grande de Arecibo Stream Connectivity Restoration Initiative





**III. Description of proposed action (describe in enough detail to allow proper evaluation of project impacts, attach additional pages as needed):**

The U.S. Fish and Wildlife Service (USFWS), through the Coastal and Fish and Aquatic Conservation Programs, will provide technical and financial assistance to reestablish and enhance river connectivity for the conservation of native freshwater species through the removal of a physical barrier in the Río Grande de Arecibo of the northcentral region of Puerto Rico. The approach came after an evaluation conducted in 2016 by the USFWS South East Aquatic Habitat Restoration Team (SEAHRT) in collaboration with the Caribbean Ecological Services Field Office (CESFO) and Puerto Rico Department of Natural and Environmental Resources (PRDNER) staff to identify priority areas in Puerto Rico for aquatic restoration. During the implementation phase of this project, Protectores de Cuencas Inc., in collaboration with the Service will, 1) Identify and submit all the required permits for the partial removal and /or modification of the low-head dam; 2) Collaborate with the SEAHRT and Coastal Program (CP) staff in the implementation phase of the project; 3) Acquire or rent the necessary equipment, materials and supplies that will be used by SEAHRT and CP staff during the implementation phase; 4) Identify potential sites to dispose debris; 5) Promote stream barrier removal to reestablish and enhance river connectivity for the benefit of the migratory aquatic fauna; 6) Identify other potential restoration practices to improve aquatic habitat and ecosystem integrity; and 7) Partner with local land management agencies and environmental groups to develop an educational public outreach initiative.

Through this project, the Service will be able to reestablish river connectivity by the partial removal/modification of a low-head dam and enhance aquatic habitat for Species of Greatest Conservation Needs such as the *Sicydium* spp. (Sirajo goby) and *Anguilla rostrata* (American eel) in the Río Grande de Arecibo. The implementation of specific aquatic habitat restoration practices within this watershed will also benefit other amphidromous freshwater native fish species and crustaceans that are considered Species of Concern. This initiative will also complement other landscape and multispecies efforts that the Service and Science Applications division are conducting in the northcentral Karst region to benefit Federal trust species.

**IV. Species and Habitats Considered:**

**A. List all federally endangered, threatened, proposed, and candidate**

**species, and describe any associated critical or proposed critical habitat that may be affected by the proposed action. Make a determination of how the proposed action may affect each:**

SPECIES/CRITICAL HABITAT	STATUS <sup>1</sup>	DETERMINATION <sup>2</sup>			RESPONSE REQUESTED <sup>3</sup>
		NE	NA	LAA	
Puerto Rican boa ( <i>Chilabothrus inornatus</i> )	E		X		
Antillean manatee ( <i>Trichechus manatus manatus</i> )	T	X			
Green Sea Turtle ( <i>Chelonia mydas</i> )	T,CH	X			
Leatherback Sea Turtle ( <i>Dermochelys coriacea</i> )	E,CH	X			
Hawksbill Sea Turtle ( <i>Eretmochelys imbricata</i> )	E,CH	X			

<sup>1</sup>STATUS: E = endangered, T = threatened, PE= proposed endangered, PT= proposed threatened, CH = critical habitat, PCH = proposed critical habitat, C = candidate species

<sup>2</sup>DETERMINATION:

E = no effect. This determination is appropriate when the proposed action will not directly, indirectly or cumulatively impact, either positively or negatively, any listed, proposed, candidate species or designated /proposed critical habitat.

A= not likely to adversely affect. This determination is appropriate when the proposed action is not likely to adversely impact any listed, proposed, candidate species or designate d/proposed critical habitat or there may be beneficial effects to these resources.

LAA= likely to adversely affect. This determination is appropriate when the proposed action is likely to adversely impact any listed, proposed, candidate species or designated/ proposed critical habitat.

<sup>3</sup>RESPONSE REQUESTED: conference, concurrence, formal consultation

## **V. Determination of effects:**

### **A. Explanation of effects of the action: include direct, indirect, interrelated, interdependent , and cumulative effects (attach additional pages as needed):**

Definitions for Effects of the Action:

Direct Effects= are those that are an immediate result of the action.

Indirect Effects= are those that are caused by the action and are later in time but are still reasonably certain to occur. They include the effects of future activities that are induced by the action and that occur after the action is completed.

Interrelated = are those that are part of a larger action and depend on the larger action for their justification.

Interdependent = are those that have no significant independent utility apart from the action that is under consideration.

Cumulative Effects = are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area.

The proposed project is within the known range of the endangered Puerto Rican boa (*Chilabothrus inornatus*). However, it is not expected that this project would adversely affect the species. The USFWS Conservation Measures for the boa will be fully implemented to avoid or minimize possible effects on the Puerto Rican boa during the project implementation. Disturbances are not expected to the boa or its habitat during and after the implementation of the proposed action. Although minor impacts may result from sediment movement downstream reaching the coastal areas, effects to marine ecosystems are not anticipated. Therefore, based on the nature of the proposed action, habitat characteristics and the implementation of conservation recommendations for the Puerto Rican boa, the project is not likely to adversely affect the PR boa or its habitat.

The proposed project will help to facilitate the confirmation of the impact of stream barriers on migratory native aquatic fauna (fish and crustaceans) by comparing the baseline data of the biotic assemblages upstream and downstream of the stream barrier prior to removal. After the removal of the physical barrier, repeated systematic surveys of the site will provide confirmation of the effectiveness of the management measure implemented on the stream biota; data of the physicochemical parameters will also provide information on how the stream habitat has changed after the barrier removal. As a result we expect to improve aquatic habitat and ecosystem integrity for the benefit of the identified freshwater species.

We anticipate that the partial removal of the low-head darn will result in habitat heterogeneity providing staging and resting places for diadromous fish species inhabiting the area. In addition, the proposed project will lessen any adverse effects that physical barriers might have on the aquatic fauna maintaining the connectivity for migratory aquatic species. Moreover, the targeted species are considered Species of Greatest Conservation Needs due to the limited habitat and migration problems caused by in-stream physical barriers. With this project we will be able to enhance approximately 25 km of riverine habitat of the targeted species.

**B. Explanation of actions to be implemented to reduce adverse effects:**

No adverse effects are anticipated from this project; therefore no additional actions are contemplated.

**VI.**

ALEXANDRA  
GALINDO ESTRONZA  
Digitally signed by ALEXANDRA  
GALINDO ESTRONZA  
Date: 2018.09.04 14:46:43 -04'00'

**Project Leader:** \_\_\_\_\_ **September 4, 2018**  
Signature Date

**VII. Reviewing Ecological Services Office (ESO) Evaluation:**

**A. Concurrence** X **Nonconcurrence**       

**B. Formal Consultation Required**

**C. Conference Required**

**D. Remarks (attach additional pages if needed):**

**VIII. Signatory Approval:**

**ESO Supervisor:** \_\_\_\_\_ **9/4/18**  
Signature Date

**Note:** The process ends here if the proposed action is "not likely to adversely affect".

**ARD Program:** \_\_\_\_\_  
Signature Date

**ARD Ecological  
Services:** \_\_\_\_\_  
Signature Date

**Note:** These signatures are required for approval of a conference report or biological opinion.

## Appendix 6. Consultation and Response of the Puerto Rico Historic Preservation Office.



GOBIERNO DE PUERTO RICO  
Oficina Estatal de Conservación Histórica  
State Historic Preservation Office

August 1, 2018

**Edwin E. Muñiz**

Field Supervisor  
Fish and Wildlife Service  
Caribbean Ecological Services  
Field Office  
P.O. Box 491  
Boquerón, PR 00622

**RECEIVED**

**AUG 13 2018**

**U.S. Fish & Wildlife Service**

SHPO 06-08-18-01 STREAM CONNECTIVITY RESTORATION INITIATIVE AT  
THE RÍO GRANDE DE ARECIBO WATERSHED OF THE NORTHCENTRAL  
REGION IN PUERTO RICO, ARECIBO, PUERTO RICO

Dear Mr. Muñiz,

Our Office has received and reviewed the above referenced project in accordance with 54 U.S.C. 306108 (commonly known as Section 106 of the *National Historic Preservation Act*) and 36 CFR Part 800: *Protection of Historic Properties*. The State Historic Preservation Officer (SHPO) is to advise and assist federal agencies and other responsible entities when identifying historic properties, assessing effects upon them, and considering alternatives to avoid or reduce the project's effects.

Our records support your finding of no historic properties affected within the project's area of potential effects.

Please note that should the Agency discover other historic properties at any point during project implementation, you should notify the SHPO immediately. If you have questions regarding this matter, please contact our Office at (787) 721-3737 or email, [ediaz@prshpo.pr.gov](mailto:ediaz@prshpo.pr.gov).

*Sincerely,*

**Carlos A. Rubio-Cancela**  
State Historic Preservation Officer

CARC/GMO/BRS/MB

Cuartel de Ballajá (Tercer Piso),  
Calle Norzagaray, Esquina Beneficencia, Viejo San Juan, P.R. 00901

PO Box 9023935, San Juan, P.R. 00902-3935  
Tel: 787-721-3737 Fax: 787-721-3773  
[www.oech.pr.gov](http://www.oech.pr.gov)



SHPO  
OFICINA ESTATAL DE  
CONSERVACIÓN HISTÓRICA  
OFICINA DEL GOBERNADOR  
STATE HISTORIC  
PRESERVATION OFFICE  
OFFICE OF THE GOVERNOR